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# SCIENCE

FRIDAY, JANUARY 19, 1917

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## THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

## ASYMMETRIC SYNTHESES AND THEIR BEARING UPON THE DOCTRINE OF VITALISM[1]

IN the history of the development of any science certain discoveries stand out boldly as epoch-making in importance. In the domain of organic chemistry the observations of Liebig and Wöhler (1826) that cyanic and fulminic acids have the same percentage composition, rank with this class of discoveries; for the establishment of this fact laid the foundation for the development of the principle of isomerism. Likewise to this class belongs the investigation of Wöhler (1828) in which he proved that urea results from the spontaneous rearrangement of ammonium cyanate, a discovery of no great significance in itself, but of the greatest importance when regarded from its bearings upon the ideas concerning organic compounds prevalent in the first quarter of the nineteenth century; for it carried with it the abandonment of the universal belief that compounds elaborated within the living organism can not be prepared synthetically by laboratory methods. Following Wöhler's classical discovery came those brilliant investigations of Pasteur (1844–49) on the tartaric acids which led to the development of our modern ideas concerning space-isomerism or stereo-isomerism.

Since it is my purpose to deal with a certain phase of stereo-isomerism I will re-

[1] Address of the vice-president and chairman of Section C, Chemistry, American Association for the Advancement of Science, New York, December, 1916.

view briefly a few of the important discoveries that led up to the investigations of Pasteur. These discoveries are outlined in the historical introduction of Pasteur's lectures delivered before the Chemical Society of Paris in 1860.

The fact that a ray of light in passing through a crystal of Iceland spar is divided into two rays had been known for many years, but it remained for Huygens and Newton in 1678 to point out that the ray of light is altered in its properties as it passes through the crystal. Later in 1808 Malus was able to show that light was similarly altered in properties by being reflected from any object and designated this change in properties by the term "polarization." Malus followed up this discovery with a number of important observations, but his early death at the age of 37 ended his brilliant career. The work, however, was continued by two young physicists Arago and Biot, and the latter devoted a long life primarily to the study of polarized light and its attending phenomena. It was Biot who observed that plates cut from certain quartz crystals rotate the plane of polarization to the right while similar plates cut from other quartz crystals rotate it to the left. In 1815 he announced to the Société philomatique the very important discovery that this property of rotating the plane of polarization is not confined to solids; for solutions of certain organic compounds, including sugar, camphor and tartaric acid likewise cause a rotation of the plane. Biot's studies led him to the definite conclusion that while both the quartz crystal and the sugar solution rotate the plane of polarization, the rotation in the two cases is due to different causes. In the former case the crystalline structure must be the influencing factor, for silica in the amorphous state does not rotate the plane of polarization. On the other hand, the ability of the sugar solution to rotate the plane of polarization must lie in the structure of the sugar molecule.

Another important observation in connection with this general subject was made by Hauy and Weiss, who noted in their study of quartz crystals that some of the crystals possessed certain faces truncating the upper edge of the prism face. They observed, moreover, that these faces or planes did not occupy the same position on all crystals; that in some, the plane appeared on (say) the right upper edge while in others it occupied a similar position on the corresponding left edge. With this difference as a basis, the crystals could be divided into two groups, the members of which are related to each other as object is to image, or as the right hand is to the left. It was Herschel who suggested (1820) that the difference in the optical activities of the quartz crystals, as noted above, might be connected with the position of these truncating planes on the crystal, and that of the two groups of crystals referred to, the members of the one group might rotate the plane of polarization in the one direction while the members of the other group might rotate it in the opposite direction. Experiments soon proved the verity of Herschel's suggestion.

### THE INVESTIGATIONS OF PASTEUR BEARING UPON ASYMMETRY

The above account gives briefly the state of the knowledge of polarization when Pasteur began his now classical investigations. In order to familiarize himself with crystals, Pasteur decided to repeat some important research in this field of study—a method which may well be recommended to all who are in training for research work. For this purpose he chose the investigations of de La Provostaye on the tartaric acids published in 1841. In this study Pasteur soon

discovered what had escaped the eyes of even so keen an investigator as de La Provostaye, namely, that the crystals of the tartrates possessed truncating planes analogous to those observed in the quartz crystals. He found, however, that in the case of the crystals of the salts of the optically active tartaric acid (dextro-tartaric acid) these planes all occupied the same relative position so that the crystals were all identical. On the other hand, the crystals of the salts of the optically inactive tartaric acid (racemic acid), like the quartz crystals, could be divided into two groups according to the position of the planes, the members of the one group being related to those of the other as object is to image. It was but a step to show that, of the two groups of the crystals formed by the salts of the inactive acid, the one group rotated the plane of polarization to the right while the other rotated it an equal amount to the left; that the acid prepared from the group of crystals which rotated the plane of polarization to the right was in every way identical with the well-known dextro-tartaric acid and that the acid prepared from the remaining group of crystals was identical with the dextro acid in every respect except that it was levorotatory.

Here then, lay the secret of the optical inactivity of racemic acid, as well as the secret of the relation of the racemic acid to the ordinary active tartaric acid.

Pasteur realized the importance of his results. Vallery-Radot in his fascinating life of Pasteur gives a vivid account of the discovery. After referring to the final experiment in which Pasteur had tested the activity of the two sets of crystals in the polarizing apparatus, the biographer continues:

> His excitement was such that he could not look at the apparatus again; he rushed out of the laboratory, not unlike Archimedes. . . . Never was there greater or more exuberant joy on a young man's lips. He foresaw all the consequences of his discovery. The hitherto incomprehensible constitution of paratartaric or racemic acid was explained; he differentiated it into right-hand tartaric acid, similar in every way to the natural tartaric acid of grapes, and left-hand tartaric acid. These two distinct acids possess equal and opposite rotatory powers, which neutralize each other when these two substances, reduced to an aqueous solution, combine spontaneously in equal quantities.

The discovery was received with the greatest interest by the French scientists. The story is well known of how Biot, then an old man, wishing to learn more about the work before presenting it to the French Academy, invited Pasteur to repeat the experiments in his laboratory, using solutions which Biot himself had prepared, and how upon the completion of the experiments he grasped Pasteur's hand, saying:

> My dear child, I have all my life so loved this science that I can hear my heart beat with joy.

Pasteur had connected the different effects of the dextro- and levo-tartaric acids with the asymmetrical character of their molecules. I quote from him:

> We know, in fact, on the one hand, that the molecular arrangement of both tartaric acids is asymmetric; on the other, that they are entirely the same, with the exception that the asymmetry is shown in opposite senses. Are the atoms of the dextro acid arranged in the form of a right-handed spiral, or are they situated at the corners of an irregular tetrahedron, or do they have some other asymmetric grouping? This we do not know. But without doubt the atoms possess an asymmetric arrangement like that of an object and its reflected image.

Following the work of Pasteur, Wislicenus in 1873 made an extended study of the different isomeric lactic acids and concluded that the existence of these could be explained only upon the assumption that their differences are due, not to different groups of atoms, but to a different arrangement of the same groups in space.

It remained for van't Hoff and Le Bel in 1874 to propose a theory which gives a satisfactory explanation of the facts. These

two scientists working independently reached almost identical conclusions at about the same time, van't Hoff presenting his views in a brochure published at Utrecht in September, 1874, while Le Bel's article appeared two months later in the November issue of the *Bulletin de la Société Chimique de Paris*. In accordance with the views advanced by van't Hoff and Le Bel every molecule containing a carbon atom attached to four different groups (a so-called asymmetric carbon atom) may exist in two forms related to each other as object is to image. The one form of molecules rotates the plane of polarization to the right, the other form rotates it an equal extent to the left. It follows, therefore, that a compound containing an asymmetric atom may be expected to exist in three forms: the dextro or *d*-form composed of those molecules which rotate the plane of polarization to the right; the levo or *l*-form composed of those molecules which rotate the plane of polarization to the left; and the inactive or racemic form which consists of a true chemical combination of the two kinds of molecules in equal quantities. It is also possible to have equimolecular inactive mixtures of the dextro and levo forms.

This theory of van't Hoff and Le Bel, well known and therefore but briefly sketched, was vigorously opposed and even ridiculed when first advanced. Kolbe referred to it in the following terms:

> A Dr. J. H. van't Hoff, stationed at the veterinary school at Utrecht, as it appears, finds no pleasure in exact chemical investigations. He has deemed it easier to mount Pegasus (evidently borrowed from the veterinary school) and in his "Chemistry in Space" to announce how the atoms lying about in the universe, appeared to him from the chemical Parnassus which he had climbed in his bold flight. . . . To criticize this writing even in a half way thorough manner is not possible, because the fantastic absurdities are entirely lacking in actual foundation and are entirely incomprehensible to the sober-minded investigator.

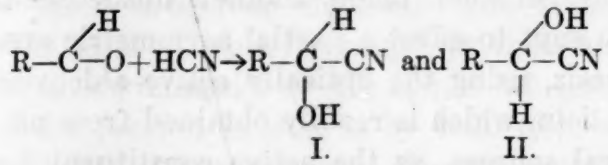
Notwithstanding these criticisms the theory advanced by van't Hoff and Le Bel has stood the test of experiment better perhaps than any other theory ever advanced within the domain of organic chemistry and has been a most potent factor in the development of stereo-chemistry.

### The Synthesis of Asymmetric Compounds

To me the most interesting problem belonging to the general subject of stereochemistry is that of synthesizing compounds containing an asymmetric group. As stated above, compounds containing such a group may exist in three forms. The early attempts to synthesize such compounds, however, always resulted in the production of equal quantities of the dextro and levo forms, which either remained as mixtures or combined to produce the racemic form. As a result, the product obtained was always optically inactive. There is nothing remarkable in this result. Indeed, it is just what one would expect; for so far as one is able to judge the chances for the atoms to combine in one of the two possible ways is the same as the chances for them to combine in the other way. It would naturally follow, therefore, that the two possible forms of molecules will be produced in numbers that are equal, or are at least approximately so. The remarkable fact is not, therefore, that the synthetic compound of the laboratory is optically inactive or so nearly so that its activity can not be detected by any instruments yet devised, but rather that compounds occurring in nature and containing an asymmetric group with very few exceptions always occur in the active form. In other words, nature's synthetic methods result apparently in the formation of the dextro or of the levo form alone, while the synthetic methods of the laboratory always lead to the production of the two forms in equal quan-

tities. This striking difference between the natural and the laboratory synthesis has attracted much attention and extended investigations have been made in recent years to solve the mystery. Nevertheless, the problem of building up from its elements the dextro or the levo form alone or the one form in excess of the other so that the resulting product is optically active, remains to-day as in the beginning, an unsolved problem.

While the synthesis of either the dextro or the levo form alone of an asymmetric compound from its elements or from optically inactive materials has never been accomplished, nevertheless, it is entirely possible to build up an asymmetric compound if we employ another already existing optically active compound as an agent for effecting the synthesis. That such a procedure is possible was shown by Fischer in 1889 in the course of his celebrated investigations on the sugars. It had long been known that the so-called aldose sugars combine directly with hydrocyanic acid. This addition introduces a new asymmetric carbon atom into the compound:



I. II.

We might naturally expect that the two possible forms (I. and II.) of the new asymmetric group will be produced in equal amounts. Fischer found, however, that when hydrocyanic acid combines with *d*-glucose, both forms of the resulting cyanogen derivative are indeed obtained, but that the one form is obtained in excess of the other. When the action is carried on with *d*-mannose the one form only is produced. This result is readily explained upon the very reasonable assumption that the manner of the addition of the hydrocyanic acid to the sugar molecule is influenced by the forces exerted by the asymmetric groups already present in the sugar molecule. In the absence of such modifying forces, that is, in compounds which do not contain asymmetric groups, the two possible forms are produced in equal quantities, but in the presence of such asymmetric groups the two forms may be produced in unequal amounts.

Now it will readily be noticed that this observation of Fischer suggests a possible way of effecting the synthesis of an optically active body from its constituent elements. For example, if one could find some method for splitting off from the molecule, the new asymmetric carbon group added to *d*-mannose in such a way that the resulting compound would contain this asymmetric group, then it is evident that the compound so produced would be optically active since it would consist of the one form only. Thus a synthesis of an optically active compound would have been effected, although it would have been made possible through the influence of a previously existing optically active compound.

While it has not been found possible to split off the newly formed asymmetric group resulting from the addition of hydrocyanic acid to *d*-mannose, nevertheless the synthesis of a number of optically active compounds has been accomplished through the application of this general principle. Such a synthesis is generally termed an asymmetric synthesis. However, such a synthesis, accomplished as it is through the assistance of an already existing optically active compound, is only partial and I shall designate it in the discussion that follows as a partial asymmetric synthesis. This term, as I shall use it, signifies the synthesis of either the dextro or levo form alone, or of the two forms in unequal amounts, effected through the assistance of an already existing optically active compound. It is

evident, then, that the production of the two forms in equal amounts with their subsequent separation from each other—a task often easily accomplished—does not constitute a complete asymmetric synthesis.

A brief discussion of the more important attempts to effect partial asymmetric syntheses follows:

1. The first serious attempt to effect a partial asymmetric synthesis was made by Cohen and Whitely in 1901. An optically active ester was prepared by heating an unsaturated acid (mesaconic acid was used) or its derivatives with levo-menthol. The resulting ester was then reduced, whereby one of the carbon atoms present was rendered asymmetric. The ester was then saponified so that the active menthyl group was eliminated, leaving methyl succinic acid containing the newly formed asymmetric group. The course of the reactions is shown in the following equations in which the abbreviation Myl represents the menthyl group, while the newly formed asymmetric carbon atom is designated by a star:

$$\begin{aligned}
&\mathrm{HOOC \cdot CH{:}\,CCH_3 \cdot COOH}\\
&\mathrm{MylOOC \cdot \overset{\downarrow}{C}H \cdot CCH_3 \cdot COOMyl}\\
&\mathrm{MylOOC \cdot CH_2{:}\,\overset{\downarrow}{C}HCH_3 \cdot COOMyl}\\
&\mathrm{HOOC \cdot CH_2{:}\,\overset{\downarrow}{C}HCH_3 \cdot COOH}
\end{aligned}$$

The resulting product, however, was inactive, showing that the dextro and levo forms had been produced in equal amounts. Pyruvic acid yielded similar results. The method selected was ingenious but did not lead to the desired end.

2. In the same year (1901) Kipping attempted to solve the problem by a method similar to that used by Cohen and Whitely. Benzoyl-formic acid was changed into an active ester by heating with borneol. The resulting ester was then reduced, whereby the carbon atom of the carbonyl group was rendered asymmetric. By hydrolysis the active bornyl radical (Byl) was removed, leaving an acid which contained the newly synthesized asymmetric group:

$$\mathrm{C_6H_5COCOOH \rightarrow C_6H_5COCOOByl \rightarrow C_6H_5\overset{*}{C}HOH\,COOByl \rightarrow C_6H_5\overset{*}{C}HOHCOOH.}$$

The results however were negative, the mandelic acid formed being inactive.

Kipping also attempted to effect a partial asymmetric synthesis through the influence of an optically active solvent. For this purpose he prepared benzoin through the action of potassium cyanide upon benzaldehyde in an alcoholic solution of camphor:

$$\mathrm{2\ C_6H_5CHO \rightarrow C_6H_5\overset{*}{C}HOHCOC_6H_5.}$$

He likewise synthesized mandelic acid nitrile by the action of hydrocyanic acid upon benzaldehyde in an alcoholic solution of camphor; pyruvic acid and methylethylketone were reduced in a concentrated solution of grape sugar. While all of these reactions led to the synthesis of compounds containing an asymmetric group, the products in each case were inactive, showing that the two forms had been synthesized in equal quantities.

3. Two years later (1902–03) Fischer and Slimmer made another unsuccessful attempt to effect a partial asymmetric synthesis, using the optically active aldehyde, helicin, which is readily obtained from natural sources, as the active constituent for influencing the synthesis. The aldehyde group was rendered asymmetric by the addition of hydrocyanic acid as well as by the action of zinc ethyl. The resulting compounds were decomposed so that one of the products formed contained the newly synthesized asymmetric group. The products, however, proved to be inactive.

4. The first successful attempt to effect a partial asymmetric synthesis was made by Marckwald in 1904. In this investigation, brucine was used as the active agent. Marckwald started with methylethylmalonic acid. This was converted into the brucine

salt. Upon heating this salt carbon dioxide was split off, rendering the central carbon atom asymmetric. The resulting salt was treated with an acid, liberating the free methylethylacetic acid:

$$\mathrm{HOOC \cdot CCH_3C_2H_5 \cdot COOH}$$
$$\downarrow$$
$$\mathrm{HOOC \cdot \overset{*}{C}CH_3C_2H_5 \cdot COOBrue.}$$
$$\downarrow$$
$$\mathrm{H \cdot \overset{*}{C}CH_3C_2H_5 \cdot COOBrue}$$
$$\downarrow$$
$$\mathrm{H \cdot \overset{*}{C}CH_3C_2H_5 \cdot COOH}$$

This product was found to be slightly levo-rotatory. The results showed that while both the dextro and levo forms of the acid had been produced, there was an excess of about 16 per cent. of the levo form.

5. Following Marckwald, MacKenzie and his co-workers carried on a series of investigations in 1904, 1905, 1906, 1907, and in 1909, in which they were able to effect a number of partial asymmetric syntheses. The principal method employed by MacKenzie was very similar to that used by Kipping. An acid of the general formula R-CO-COOH was selected and changed into an optically active ester by combination with an active alcohol, such as amyl alcohol, borneol or menthol. The carbon atom of the carbonyl group was then rendered asymmetric by the action of Grignard's reagent as well as by reduction.

The resulting products, freed from the active alcohol groups, proved to be slightly active, showing that a partial asymmetric synthesis had been accomplished. A comparison of the results obtained by the use of amyl alcohol, borneol and menthol led to the conclusion that the greater the optical activity of the influencing group present, the greater is the extent of the asymmetric synthesis.

MacKenzie was also able to synthesize both dextro and levo tartaric acids in an ingenious way (1907). Fumaric acid was changed into the active bornyl or menthyl ester and this ester was then oxidized by potassium permanganate. The two central carbon atoms were thereby rendered asymmetric:

$$\mathrm{HOOC \cdot CH{:}\,CH \cdot COOH}$$
$$\downarrow$$
$$\mathrm{BylOOC \cdot CH{:}\,CH \cdot COOByl}$$
$$\downarrow$$
$$\mathrm{BylOOC \cdot \overset{*}{C}HOH \cdot \overset{*}{C}HOH \cdot COOByl}$$
$$\downarrow$$
$$\mathrm{HOOC \cdot \overset{*}{C}HOH \cdot \overset{*}{C}HOH \cdot COOH}$$

On saponification the resulting product yielded an optically active mixture of tartaric acids, indicating an excess of either the dextro or levo form. When menthol was used as the active agent the levo acid was in excess; when borneol was used, an excess of the dextro acid was obtained.

6. Mention should be made of the attempts to effect the synthesis of compounds containing asymmetric groups other than those of carbon. Smiles, in 1905, effected the synthesis of compounds containing asymmetric sulfur groups while E. and O. Wedekind, in 1908, built up asymmetric nitrogen groups. In neither case, however, were partial asymmetric syntheses effected. The method employed by E. and O. Wedekind was similar to that employed by Kipping in that the reactions were carried out in an optically active solvent such as *l*-menthol and *d*-limonene.

7. A distinct advance in our knowledge of asymmetric syntheses was made by Rosenthaler in 1908. Recalling the discovery of Pasteur that certain enzymes have a different action upon the dextro and levo forms of some of the sugars, Rosenthaler attempted an asymmetric synthesis by the addition of hydrocyanic acid to benzaldehyde in the presence of emulsin. By hydrolyzing the resulting compound pure levo-mandelic acid was obtained. Rosenthaler's results are especially significant; for while all the other attempts to effect partial asymmetric syntheses yielded both active forms, but with the one in slight excess of the other, Rosenthaler obtained

the one form only. It may be, however, that the reactions which Rosenthaler employed gave rise to both forms and that the dextro form was destroyed as fast as it was synthesized, through the action of the emulsin.

8. The most important contribution to the subject of asymmetric syntheses in recent years is that made by Bredig and Fiske in 1912. Bredig and Fajans had previously shown that the dextro and levo camphor-carboxylic acids decompose with different speeds in the presence of active bases. When the reaction is carried out in nicotine solution, for example, the speed of decomposition of the *d*-acid is about 13 per cent. greater than that of the *l*-acid—results that are similar to those of Dakin, who studied the hydrolysis of mandelic esters in the presence of lipase. With this information concerning the selective action of the alkaloids in mind, Bredig and Fiske attempted to utilize this property of alkaloids in effecting asymmetric syntheses. For this purpose they selected the same reaction that Rosenthaler had used, namely, the addition of hydrocyanic acid to benzaldehyde, but substituted an alkaloid for the emulsin. The results were decisive. In the presence of quinine an excess of dextro mandelic acid was formed, while quinidine gave an excess of the corresponding levo compound. The alkaloid acted as a catalytic agent since the results were obtained by the use of relatively small amounts of the bases.

While all the methods for effecting partial asymmetric syntheses so far discussed differ somewhat in detail, yet they are all fundamentally the same. In each case the object has been to bring about an asymmetric synthesis through the agency of the forces exerted by a previously existing asymmetric group. Now it is perfectly rational to suppose that in place of the forces exerted by an asymmetric group, one might utilize the forces acting in a strong magnetic field or those exerted in either plane or circularly polarized light. Accordingly, many attempts have been made to employ these agencies. Pasteur himself used the magnetic field as the active agent, as did also Boyd (1896). Meyer, in 1903, believing that the forces exerted in a magnetic field are not of the same character as those exerted by an asymmetric group, attempted to improve the experiment through the combined influence of a magnetic field and polarized light. Henle and Haakh (1908) concluded that a reaction that proceeds in the absence of light is not likely to be influenced by the action of polarized light. Accordingly they attempted to effect an asymmetric synthesis by the decomposition of certain acids of the type of malonic acid, through the action of light in the presence of uranium compounds—a reaction which will take place under the conditions of the experiment, only in the presence of light. In all of these investigations, however, no positive results were obtained.

The results of all the attempts to effect either a partial or complete asymmetric synthesis may be summed up as follows: in so far as we are able to detect with instruments at present constructed, an asymmetric compound synthesized from its constituent elements or from optically inactive compounds is always obtained in the inactive form. The optically active forms can be prepared synthetically only through the assistance of previously existing optically active compounds.

In making this general statement I am disregarding the work of Stoklosa and his co-workers (1913), who claim to have prepared optically active sugars through the action of ultra-violet light upon a mixture of carbon dioxide and hydrogen in the presence of potassium hydrogen carbonate. Stoklosa's results are of the greatest im-

portance if true, but serious doubts have been cast upon their accuracy so that they have not been at all generally accepted.

WILLIAM MCPHERSON
OHIO STATE UNIVERSITY

*(To be concluded)*

## THE COMMITTEE OF ONE HUNDRED ON SCIENTIFIC RESEARCH OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE committee held its fourth meeting at the Hotel Belmont, New York City, convening shortly after two o'clock on the afternoon of December 26, 1916. Mr. Pickering was in the chair and others recorded as present were:

Raymond F. Bacon, Franz Boas, N. L. Britton, Alfred H. Brooks, Ernest W. Brown, Walter B. Cannon, J. J. Carty, J. McK. Cattell, C. R. Cross, Chas. B. Davenport, W. M. Davis, Henry H. Donaldson, H. L. Fairchild, Irving Hardesty, G. Ross Harrison, L. O. Howard, Ales Hrdlicka, W. J. Humphreys, Edward Kasner, A. E. Kennelly, Irving Langmuir, Berthold Laufer, Frederic S. Lee, Jacques Loeb, D. T. MacDougal, J. C. Merriam, G. A. Miller, T. H. Morgan, H. V. Neal, Edw. L. Nichols, A. A. Noyes, Richard M. Pearce, M. I. Pupin, Jos. W. Richards, F. K. Richtmyer, Peyton Rous, H. N. Russell, Frank Schlesinger, Geo. Otis Smith, J. Stieglitz, Chas. R. Stockard, E. L. Thorndike, A. M. Tozzer, Charles R. Van Hise, John B. Watson, A. G. Webster, David White, W. R. Whitney, Edmund B. Wilson, W. M. Wheeler, R. M. Yerkes.

After introductory remarks by the chairman, the secretary reported that, since the organization of the committee at Atlanta four years ago, it had lost by death: Charles E. Bessey, professor of botany, University of Nebraska; Theodore Gill, professor of zoology, George Washington University; Karl E. Guthe, professor of physics, University of Michigan; Joseph A. Holmes, chief of the Bureau of Mines, Washington, D. C.; Charles S. Minot, professor of comparative anatomy, Harvard Medical School, and F. W. Putnam, professor emeritus of anthropology, Harvard University. There had been added to the committee: Raymond F. Bacon, director of the Mellon Institute for Industrial Research, the University of Pittsburgh; W. B. Cannon, professor of physiology, Harvard Medical School, and John C. Merriam, professor of paleontology, the University of California.

Since the meeting last year at Columbus the following subcommittees in different sciences had been appointed:

*Mathematics:* G. A. Miller, *Chairman,* Edward Kasner, E. H. Moore, W. F. Osgood, E. B. Van Vleck.

*Astronomy:* Edward C. Pickering, *Chairman,* E. W. Brown, E. B. Frost, H. N. Russell, F. Schlesinger.

*Physics:* Arthur G. Webster, *Chairman,* C. E. Mendenhall, Ernest Merritt, R. A. Millikan, M. I. Pupin.

*Chemistry:* Julius Stieglitz, *Chairman,* I. Langmuir, G. N. Lewis, W. A. Noyes, T. W. Richards.

*Engineering:* A. E. Kennelly, *Chairman,* J. W. Richards, A. Sauveur, A. N. Talbot, C. C. Thomas.

*Geology and Geography:* Wm. M. Davis, *Chairman,* Alfred H. Brooks, L. C. Glenn, C. K. Leith, Bailey Willis.

*Botany:* George T. Moore, *Chairman,* D. H. Campbell, R. A. Harper, L. R. Jones, B. E. Livingston.

*Zoology:* Edwin G. Conklin, *Chairman,* F. R. Lillie, T. H. Morgan, G. H. Parker, Jacob Reighard.

*Anatomy:* Ross G. Harrison, *Chairman,* F. P. Mall, C. R. Stockard, C. M. Jackson, Irving Hardesty.

*Pathology:* Richard M. Pearce, *Chairman,* Theodore C. Janeway, Eugene L. Opie, Peyton Rous, H. Gideon Wells.

*Physiology:* W. B. Cannon, *Chairman,* Joseph Erlanger, Theodore Hough, Frederic S. Lee, Walter J. Meek.

*Psychology:* J. McKeen Cattell, *Chairman,* C. E. Seashore, E. L. Thorndike, John B. Watson, Robert M. Yerkes.

*Anthropology:* Franz Boas, *Chairman,* A. Hrdlicka, Alfred L. Kroeber, Berthold Laufer, Alfred M. Tozzer.

Reports were presented by the chairmen of nearly all the subcommittees. The report of the subcommittee on industrial research, presented by Mr. Bacon, was a special order, and by invitation was discussed by Mr. J. J. Carty, chairman of a committee of similar scope of the National Research Council and by Mr. F. K. Richtmyer, secretary of a corresponding committee of the American Physical Society.

This report, which was further discussed by several members, was printed in the issue of SCIENCE for January 5.

Other reports were presented, as follows:

Research on the Pacific Coast: Mr. Merrian.
Research Funds: Mr. Cross.
The Training of Students for Research: Mr. Brown.
Mathematics: Mr. Miller.
Astronomy: Mr. Pickering.
Physics: Mr. Webster.
Chemistry: Mr. Stieglitz.
Engineering: Mr. Kennelly.
Geology and Geography: Mr. Davis.
Zoology: Mr. Conklin.
Anatomy: Mr. Harrison.
Pathology: Mr. Pearce.
Physiology: Mr. Cannon.
Psychology: Mr. Cattell.
Anthropology: Mr. Boas.

The reports of the chairmen of the subcommittees were in most cases preliminary. They were discussed by various members. Those containing definite results or recommendations will be printed.

It was reported to the committee that, at the request of the National Research Council, the Committee on Policy of the American Association for the Advancement of Science had authorized the appointment by the president of the association of a committee on cooperation to include himself. The other members appointed by the president were: Mr. Nichols, chairman of the Committee on Policy, and Mr. Howard, permanent secretary of the association. Mr. Nichols and Mr. Howard had met in New York with Mr. Noyes and Mr. Conklin, representing the National Research Council, and took the following action:

The Committee on Cooperation recommends (1) that the Committee of One Hundred on Scientific Research of the American Association for the Advancement of Science cooperate with the National Research Council in those research movements in which both organizations are interested and especially in order to avoid duplication of effort that might arise from individual action of the two groups of committees which have already been appointed in the different sciences; (2) that the Committee of One Hundred, of the Association, cooperate with the National Academy of Sciences and the national scientific societies in the formation of single committees in the various branches of science, with the understanding that the present members of the association committees will become members of these committees of the National Research Council.

On motion of Mr. Noyes, this action was approved, except the final clause "with the understanding that the present members of the association committees will become members of these committees of the National Research Council." Mr. Noyes moved that:

In order to effect the cooperation provided by the preceding vote, the Committee of One Hundred on Research designate through its chairman members of the association to serve as members of the research committees of the National Research Council devoted to the various branches of science, with the understanding that those committees will consist of members designated in equal or approximately equal numbers by the association, the National Academy of Sciences, and the national scientific society representing the branch of research involved.

After discussion this motion was carried.

On motion of Mr. Boas, a subcommittee was authorized on cooperation between municipalities and incorporated institutions engaged in research.

The committee adjourned shortly after five o'clock to meet at two o'clock on the afternoon of the first day of the next annual meeting of the association, which will be on December 28, at Pittsburgh, Pa. J. McKeen Cattell,

*Secretary*

## SCIENTIFIC EVENTS

### CONGRESS ON MEDICAL EDUCATION, PUBLIC HEALTH AND MEDICAL LICENSURE

The next Congress on Medical Education, Public Health and Medical Licensure, participated in by the Councils on Medical Education and on Health and Public Instruction of the American Medical Association, the Federation of State Medical Boards of the United States and the Association of American Medical Colleges, will be held at the Congress Hotel, Chicago, on February 5 and 6, 1917. According to the *Journal* of the American Medical Association the program of Monday morning, February 5, will be on medical education. The program follows:

Opening of the Conference, Dr. Arthur Dean Bevan, chairman of the council on medical education, Chicago.

"Progress of the Year in Medical Education," Dr. N. P. Colwell, secretary of the Council on Medical Education, Chicago.

"The Problem of Higher Degrees in Medicine," Dr. Horace D. Arnold, dean, Harvard Graduate School of Medicine, Boston.

Symposium: "Economy of Time in Preliminary and Medical Education." Dr. John L. Heffron, president of the Association of American Medical Colleges, Syracuse, N. Y. Hon. P. P. Claxton, United States Commissioner of Education, Washington, D. C. President Harry Pratt Judson, University of Chicago. Discussion by President George E. Vincent, of the University of Minnesota, Minneapolis, and Professor C. H. Judd, University of Chicago.

On Monday afternoon the general topic will be medical licensure. The program follows:

"Practical Examinations by State Licensing Boards," by Dr. Walter P. Bowers, Secretary of the Massachusetts Board of Registration in Medicine, Boston.

"Minnesota Practical Examinations—As They Are and As We Should Like to Have Them," Dr. Annah Hurd, member of the Minnesota State Board of Medical Examiners, Minneapolis.

Discussion opened by Dr. W. J. Means, chairman, Executive Council, Association of American Medical Colleges, Columbus, Ohio.

Report of Examination Held by the National Board of Medical Examiners, Dr. Isadore Dyer, a member of the National Board and Dean of the Tulane University of Louisiana School of Medicine, New Orleans.

Discussion opened by Dr. John M. Baldy, president, Pennsylvania Bureau of Medical Education and Licensure, Philadelphia.

"The Problem of the Medical Cults," Dr. David A. Strickler, president of the Federation of State Medical Boards and secretary of the Colorado State Board of Medical Examiners, Denver.

Discussion opened by Mr. Harry E. Kelly, formerly attorney for the Colorado State Board of Medical Examiners, Chicago.

On Tuesday morning public health topics will be discussed. The program follows:

Opening of the Conference, Dr. Frank Billings, chairman of the Council on Health and Public Instruction, Chicago.

"Public Health Training in Medical Colleges," Dr. George E. Vincent, president, University of Minnesota, and president-elect, Rockefeller Foundation.

"What Training Should the Public Health Officer Receive in Medical Colleges," Dr. Hermann E. Biggs, state commissioner of health, New York.

Discussion opened by Dr. Victor C. Vaughan and Dr. S. J. Crumbine.

On Tuesday afternoon there will be a popular discussion of topics relating to medical licensure. The program follows:

"State Regulation of the Practise of Medicine an Educational Problem," Professor Edmund J. James, president, Illinois State University.

"The State Regulation of the Practise of Medicine as an Executive Problem," Honorable James M. Cox, governor of Ohio.

Discussion opened by Dr. C. St. Clair Drake, Dr. W. B. Hinsdale and Dr. William P. Best.

## ADDRESSES AND LECTURES

AT the thirteenth annual meeting of the Association of American Geographers held in New York, a symposium on "The Geography of the War," was conducted by Professor Douglas Wilson Johnson, of Columbia University, the program being as follows:

### INTRODUCTION

"The Geographic Factor in Military Problems," by Douglas W. Johnson.

### THE WAR ON LAND

"The Plains of Northern France," by Sumner W. Cushing.

"Rivers and Marshes of the Eastern Front," by Lawrence Martin.

"The Danube Valley and the Balkan Complex," by Ellsworth Huntington.

"The Carpathian Mountains and Transylvanian Alps," by Emmanuel De Martonne.

### THE WAR ON WATER

"Geographic Aspects of the War on Water," by J. Paul Goode.

### THE WAR IN THE AIR

"Geographic Aspects of the War in the Air," by R. DeC. Ward.

### ECONOMIC EFFECT OF THE WAR

"Economic Geography of the War," by J. Russell Smith.

DR. S. W. WILLISTON, of the University of Chicago, gave a lecture on "The Earliest

Known Air-breathing Vertebrates" under the auspices of the Science Club of the University of Wisconsin on December 16, 1916. Among future lecturers are the following:

Dr. E. C. Rosenow, of the Mayo Foundation, on "The Etiology of Epidemic Poliomyelitis," on January 12, 1917.

Professor Robert DeC. Ward, of Harvard University, on "The Weather and the War," on January 19, 1917.

Dr. Frederic S. Lee, of Columbia University, on a subject yet to be announced, on February 12, 1917.

Professor G. A. Miller, of the University of Illinois, on "The Function of Mathematics in Scientific Research."

Professor C. S. Slichter, of the University of Wisconsin, on "Science at the University of Alexandria."

A COURSE of six lectures on psychopathology is being given by Dr. E. E. Southard, professor of neuropathology in the Harvard Medical School, before the department of psychology, Columbia University. The lectures given at four o'clock, in Schermerhorn Hall, are:

Tuesday, January 2, "Neuropathology and Psychopathology."

Wednesday, January 3, "The Brains of the Feeble-Minded."

Wednesday, January 31, "Frontal Lobe Functions."

Thursday, February 1, "The Analysis of Delusions."

Thursday, February 8, "The Unconscious."

Friday, February 9, "Psychopathia."

THE following program of lectures is offered for this season by the Ottawa Field Naturalists Club:

December 16, "A Journey through Space," by Dr. J. S. Plaskett, Dominion Observatory, Ottawa.

January 9, "Are Our Forests Vanishing—What Are We Doing to Perpetuate Them"? by Mr. R. N. Campbell, director of forestry, Ottawa.

January 23, "Our Winter Birds," by Dr. N. Y. Williams, Geological Survey, Ottawa.

February 6, "The Animals of Arctic Canada," by Dr. R. M. Anderson, lately in charge of southern scientific party of Canadian Arctic Expedition.

February 20, "Fishes and the Fishing Industry," by Mr. Andrew Halkett, naturalist, Naval Department, Ottawa.

March 6, "The Conservation of Wild Life in Canada," by Dr. C. Gordon Hewitt, Dominion Entomologist, Ottawa.

March 20. Annual meeting. Presidential address: "Recent Archeological Work in Canada," by Mr. Harlan I. Smith, Geological Survey, Ottawa.

## A SCHOOL OF FISHERIES AT THE UNIVERSITY OF WASHINGTON

A SCHOOL of fisheries will be established at the University of Washington within the next two years, if the appropriation bill for the university is passed as it now stands. The need for scientific study of fishing problems is already felt to so great an extent that Professors Kincaid and E. Victor Smith, of the biology department, are devoting much time to the scientific phases of the industry. Professor Kincaid is investigating and fostering the oyster industry on the Pacific coast and Professor Smith is studying salmon and salmon hatcheries, particularly.

The passage of the required appropriation by the legislature will make possible the addition of an expert authority on fishing and fisheries, the addition of laboratory equipment, the enlargement of the scope of the university and the addition of increased laboratory space to handle problems that arise through study.

The university, in connection with the Seattle Port Commission, has invited the *Albatross,* the official ship maintained by the United States Bureau of Fisheries for the scientific investigation of the fishing industry, to winter in the fresh waters of Lake Union, which wash one edge of the campus. Plans are being considered that may make the *Albatross* available for students and instructors. The ship works with a crew of seventy men and three experts and centers its activity in the North Pacific Ocean. At present it is investigating tuna fishing off the coast of southern California. If the *Albatross* is made available for students and professors, particularly those interested directly in the fishing industry, it will serve as a practical laboratory wherein can be solved the problems that are confronting the industry along the Pacific seaboard.

## SCIENTIFIC NOTES AND NEWS

PROFESSOR REID HUNT, of the Harvard Medical School, has been elected president of the American Society of Pharmacology and Experimental Therapeutics.

AT the fifteenth annual meeting of the American Anthropological Association held in New York, from December 26 to 29, officers for the ensuing year were elected as follows: *President,* Alfred L. Kroeber, Affiliated Colleges, San Francisco; *Secretary,* Alfred M. Tozzer, Harvard University; *Treasurer,* Neil M. Judd, U. S. National Museum; *Editor,* Pliny E. Goddard, American Museum of Natural History.

AT the recent thirtieth anniversary celebration of the Michigan College of Mines, Dr. M. E. Wadsworth, the first president of the college, now emeritus dean and professor of mining geology in the school of mines of the University of Pittsburgh, gave the address, his subject being "The Michigan College of Mines in the Nineteenth Century."

AT the meeting of the Philosophical Society of Washington on January 20, the retiring president, Dr. Lyman J. Briggs, will give the address on "The Living Plant as a Physical System."

THE Society of Chemical Industry has awarded the Perkins medal to Dr. Ernst Twitchell. The presentation will be made by Dr. Charles F. Chandler on the evening of January 19. It will be followed by addresses by Dr. A. C. Langmuir on "The Twitchell Process in the Glycerin Trade," and by Martin H. Ittner on "The Twitchell Process in the Soap and Candle Industry."

ACCORDING to the *Journal* of the American Medical Association, the Alvarenga prize, awarded annually by the Swedish Medical Association, has for 1916 been given to Dr. E. Nilsson for his comprehensive study of the physical development and fitness for military service of the young men of Sweden between 1861 and 1913. The association distributed eleven other prizes. The jubilee prize was given to H. B. Lundborg for his medical-biologic study of generations of certain families in Sweden totaling 2,232 members. He traced the working of the Mendelian laws of heredity through nearly 200 years.

PROFESSOR S. A. FORBES, of the department of entomology of the University of Illinois, has been called to Washington, D. C., to consult with the members of the United States Bureau of Entomology, in regard to formulating plans for a campaign against the Hessian fly, of which Professor Forbes has made a study.

DR. F. R. WATSON, of the department of physics of the University of Illinois, who has made several years' research on the subject of acoustics, is being consulted by the United States navy officials concerning the acoustical conditions necessary for sound-proof radio rooms on battleships. It has become highly important that the wireless operator on a battleship be able to receive messages without interruption by outside noises, and the Navy Department is searching for a sound-proof room where the operator can work without interference.

NORTHWESTERN UNIVERSITY has appointed a local committee to cooperate with the National Research Council in its service for the United States government. The committee is composed of the following persons: *For the board of trustees,* Messrs. James A. Patten, Irwin C. Rew, William S. Mason, Theodore W. Robinson. *For the alumni,* Dr. Chas. H. Mayo, Rochester, Minn., Dr. W. E. Danforth, Evanston, Ill. *For the faculty,* Professors Henry Crew, D. R. Curtiss, Ulysses S. Grant, Philip Fox and William A. Locy, of the College of Liberal Arts; Professors A. B. Kanavel, A. I. Kendall, J. H. Long and S. W. Ranson, of the Medical School; Professor John H. Wigmore, of the Law School; Professor O. H. Basquin, of the College of Engineering; and Professors Arthur D. Black and Thomas L. Gilmer, of the Dental School.

THE *Aurora,* under the command of Captain Davis, sailed from Port Chalmers, New Zealand, for the Antarctic on December, with Sir Ernest Shackleton on board. Sir Ernest will command the land operations for relief of the

members of the expedition marooned in Ross Sea, and is hopeful of finding Lieutenant Macintosh's party well. Before the departure of the *Aurora* a civic reception was given at Dunedin in honor of Sir Ernest Shackleton, who arrived there in company with Dr. R. McNab, minister of marine.

Dr. Barton Warren Evermann, of the Museum of the California Academy of Sciences, spent a portion of December in the east. He represented the academy as a delegate at the dedication of the new building of ceramics at the University of Illinois. At the annual meeting of the Indiana Academy of Science at Indianapolis, on December 8 and 9, which was devoted chiefly to papers dealing with a century of science in Indiana, he presented a paper on "A Century of Zoology in Indiana." At a meeting of the Washington Biological Society Dr. Evermann spoke on the work the California Academy of Sciences is doing in the installation of habitat groups, illustrating his remarks with colored slides. The same address was given at Butler University.

Professor R. A. Millikan, of the University of Chicago, will give on the Hitchcock Foundation at the University of California, the following lectures:

"Electricity in the Nineteenth Century."
"X-rays and the Birth of the New Physics."
"The Electron—Its Isolation and Measurement."
"Brownian Movements and Sub-electrons."
"The Structure of the Atom."
"The Nature of Radiation."

Professor E. P. Lewis, of the University of California, recently lectured at the State University of Iowa on the following subjects: "The Multiple States of Nitrogen as Indicated by Its Spectra," "The Spectroscopic Exploration of the Heavens," and "The Electrical Properties of Flames."

Dr. Lewellys F. Barker, of the Johns Hopkins University, delivered an address on "Internal Secretions," before the Medical Society of the City and County of Denver, on December 26.

At the stated meeting of the Geographic Society of Chicago on January 12, Professor Emmanuel de Martonne, associate professor of geography, of the University of Paris, gave an illustrated lecture entitled, "The Battle Fields of France."

John Finlayson, an explorer, for whom Finlayson River and Finlayson Lake in Yukon territory were named, died on January 8, aged one hundred and five years. Finlayson, who was a native of Scotland, prospected and mined gold in California and Oregon until he was eighty-six years old and then went to British Columbia and Yukon territory, where he explored large areas in which white men had never penetrated.

Mr. Daniel Oliver, F.R.S., died on December 23, at his residence at Kew, in his eighty-seventh year. He was professor of botany at University College, London, from 1861 to 1888, and afterwards keeper of the herbarium and library at Kew Gardens.

Mr. F. W. Levander, editor of the *Journal* and *Memoirs* of the British Astronomical Association, died on December 20, aged seventy-seven years.

Professor Jean Baptiste A. Chauveau, the eminent biologist, member of the Section of Agriculture of the French Academy of Sciences and of the Academy of Medicine, died on January 4, in Paris.

The manuscript for a report on "The Peat Deposits of Connecticut" was in the hands of Dr. Charles A. Davis, of the Bureau of Mines, at the time of his death. Careful search has failed to locate this manuscript. It is possible that it had been sent for criticism to some scientific worker and had not been returned. Any one who has knowledge regarding this manuscript is requested to address Professor Herbert E. Gregory, Yale University, New Haven, Conn.

At the first session of the American Congress on Internal Medicine, held in New York on December 28 and 29, there was founded the new American College of Physicians, and sixty-five physicians were given fellowships, the selection having been made by the council of the congress.

MESSRS. JOHN WILEY AND SONS, INCORPORATED, write that they supply filing-card announcements of their new books covering scientific and technical subjects, in accordance with the plan recommended by Mr. Wilhelm Segerblom in the issue of SCIENCE for January 5. They will send copies of these cards to those who may be interested.

## UNIVERSITY AND EDUCATIONAL NEWS

THE Billings family of Chicago, headed by Mr. C. K. G. Billings, has given one million dollars to the University of Chicago toward the endowment of the medical school. The money is to be used to provide a hospital in connection with the school.

THE late Mr. John D. Archbold has bequeathed the sum of $500,000 to Syracuse University.

MR. JACOB H. SCHIFF has given the sum of $50,000 to New York University toward the fund of $300,000 for the division of public affairs in the school of commerce.

THE alumni of Harvard University plan to collect a fund of ten million dollars for the permanent endowment fund of the university.

PROFESSOR A. A. NOYES, director of the research laboratory of physical chemistry at the Massachusetts Institute of Technology, will spend the next five months at Throop College, Pasadena, Cal., where the new chemistry building will be occupied about February 1.

DR. ROSWELL ANGIER, assistant professor of psychology at Yale University, will during the second half year give at Yale University one of the courses given by the late Hugo Münsterberg. The other courses will be given by Assistant Professor H. S. Langfeld and Dr. L. T. Troland.

THE *Journal* of the American Medical Association states that the senate of Queen's University, Kingston, Ont., has issued a memorandum covering its objections to the action of the University of Toronto in deciding to establish in 1918 a six-year academic course in medicine. A conference had been held between representatives of the two universities but no other universities interested in Canada had been asked to participate in that conference. Queen's University says that the proposals come at a time when there is an unusual demand for the services of medical men from the British and Canadian governments, and that the great need for medical men will not immediately cease when the war is over.

## DISCUSSION AND CORRESPONDENCE

### THE INFLUENCE OF DISEASE IN THE EXTINCTION OF RACES

OSBORN[1] has called our attention to the part disease may have played in the extinction of certain mammalian groups especially. He based his suggestion on the prevalence of certain diseases among modern mammals, such as Texas fever, "rinderpest," biliary fever and the disease transmitted by the tse-tse fly. He says:

> Thus in these diseases we have all the conditions favorable for the wide distribution of insect-borne diseases which in past times may have attacked various types of quadrupeds and resulted in extermination before natural immunity was acquired.

He did not, however, cite any instances in which disease is known to have played a part among the fossil vertebrates, and it is not likely that epidemic diseases of which he spoke should leave an impress on the skeleton.

The writer[2] has already indicated how a study of pathological lesions on fossil bones may show something of the widespread nature of disease in geological time. During the past few months there have been accumulated evidences of at least a score of diseases which are suggested by the lesions found on the petrified skeletal remains. Since the detailed description of these will appear elsewhere, it will only be necessary to say here that disease, as indicated by the above-mentioned lesions, was widespread quite early in the history of the early vertebrates. Pathological bones have so far not been noted in the early or

[1] H. F. Osborn, *American Naturalist*, Vol. XL., p. 836, 1906.

[2] SCIENCE, N. S., Vol. XLIII., No. 1108, pp. 425–426, 1916. *American Journal of Science*, Vol. XLI., pp. 530–531, 1916.

middle Paleozoic, but in the Permian diseased bones have been described by Renault, which were afflicted with caries, and he was able to discern something of the nature of the bacteria producing these lesions. Walcott[3] has indicated the presence of bacteria in a much earlier period but, so far as I am aware, nothing of the diseased nature of fossil forms is known earlier than that stated above.

The lesions so far studied are the results of accidents, or of infections and none of them are very extensive. It is improbable that any of the lesions so far studied were so severe that the life of the individual afflicted was endangered. Certainly none of them are severe enough to have endangered the race. Troxell[4] has suggested in the description of a pathologic camel phalanx from the Pleistocene of Texas:

> The interesting pathologic phalanx is probably a result of exostosis or uncontrolled deposition of bony material. The bone was not broken, because it shows the same length as the normal one of the same size. Possibly the disease which caused the death of the individual also contributed to the destruction of the species.

It is to be doubted if lesions of this nature are ever fatal. They may result in the loss of usefulness of the member afflicted and in the case of the camel, aside from a stiffness in the foot afflicted, probably no other result was noticeable. Troxell has mentioned that the introduction of swampy conditions into that region was instrumental in the extinction of the fauna, and it is to be further noted that the swampy condition also produced the arthritic lesion in the camel phalanx, since arthritides are more commonly found in animals inhabiting moist places, and are particularly severe in extinct cave-inhabiting and fossorial animals.

It is not my intention to contend that disease has not been influential in the extinction of races; it probably has been; but those diseases which have left an impress on the fossilized skeleton certainly can not be regarded as among those diseases which would produce widespread extinction. Some other has been the dominant factor. Among the labyrinthodonts, for instance, there is no evidence of disease on the skeletons, and we know that after a sudden rise and world-wide distribution of species, suddenly the whole group went out of existence. The same may be said of other early groups of vertebrates. The present results of the study of fossil pathology indicate the early appearance in geological time and widespread distribution of diseases of many kinds, but none of them, so far as these lesions may be interpreted, were sufficiently severe to have played a part in the extinction of any of the known races of vertebrates. They are to be regarded rather as chronic infectious or constitutional diseases which may have played a part in extinction, but there must have been some other and more powerful ally which is at present unknown.

Roy L. Moodie

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[3] C. D. Walcott, 1915, *Proc. Natl. Acad. Sci.*, April, 1915, pp. 256–257.

[4] E. L. Troxell, 1915, *Amer. Journ. Sci.*, Vol. XXXIX., p. 626, Fig. 14.

## VERTICAL FILING FOR PAMPHLET COLLECTIONS

In the issue of Science for November 24 Professor Storer calls attention to the important matter of properly caring for pamphlet collections. He also brings together in very serviceable form the data regarding the various methods which have been used in storing pamphlets. The writer merely wishes to add some items from his experience in using for this purpose ordinary commercial vertical filing cases.

When this system is used the pamphlets are placed in the drawers of the cabinet face forward and with the back of the pamphlet uppermost. It is thus possible to read the back title if the pamphlet bears one, or to separate the pamphlets slightly as one would cards in a card index and thus note the title printed or written on the front cover. Guides are inserted at convenient intervals to assist in finding the particular group of pamphlets desired. These guides may provide a series of

subdivisions as minute as desired, though in practise an average of one guide per inch will be found to be a generous allowance. Any pamphlet in the series may be found and removed without disturbing others, or the whole group bearing upon a single subject may be located instantly.

It goes without saying that the publications are protected in the most complete manner from dust, light and accidental injury and are at the same time kept perfectly flat and under light pressure.

The total floor space occupied is little if any greater than is required for storage on shelves. The horizontal extent of the case along the wall is less than in other types of storage. The latter point is often of great importance, due to the limited amount of wall space in many offices. Furthermore, the vertical file may be placed in the center of the floor if the room happens to be a large one. The entire cabinet with its contents can be moved from one location to another with no risk of disarranging the collection.

Storage in this manner is not as expensive as is ordinarily supposed. A vertical filing case which I have just received for my own use contains filing space equal to 110 inches of shelving. The cost is about twelve and one half cents per inch, without guides. This is not a transfer case, but a well-made five-drawer upright unit, invoice size. It is steel construction inside with oak exterior. Data are not at hand regarding the cost of filing in pamphlet cases, but shelving with closed dust-proof back if made of selected lumber and well finished would cost probably from seven to ten cents per lineal inch of filing space. If to this be added the cost of pamphlet cases the expense of the method can not be much less than that of vertical filing. The convenience of the latter is such that it would appear advisable to investigate it closely in every case before adopting another system. It offers particular advantages for personal use.

It should be added that the file that I am using accommodates papers with a greatest dimension of ten and one fourth inches. This will provide for most separates, though there are of course a few which are too large. Larger drawers will cost about the same per cubic inch, but correspondingly more per lineal inch.

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UNIVERSITY OF KANSAS

### PHRENOLOGY

IT is gratifying to report the receipt of the following communication, relating to the lecture on "Phrenology" which was referred to in SCIENCE of December 29. The letter is dated January 4, and is signed by Professor Wm. A. Wilbur, dean of Columbian College, George Washington University.

Following your letters of December 21 and December 23, concerning an announced lecture on phrenology before the Enosinian Society, and following a letter of December 26 from Dr. Frank Baker, relating to the same subject, President Stockton directed me to see that the lecture was not given. On December 28 I notified the president of the society of President Stockton's directions in the matter, and I am in receipt from him of a letter of January 3 cancelling all arrangements for the lecture referred to.

President Stockton directed me to say that he felt sure you would wish to give this action of the university as wide publicity as the announcement and note over your signature in the issue of SCIENCE of December 29, 1916.

A. HRDLICKA
U. S. NATIONAL MUSEUM,
WASHINGTON, D. C.

## QUOTATIONS

### THE TEACHING OF SCIENCE IN GREAT BRITAIN

WHILE discussion is in progress as to the right principles upon which science, now beginning to be recognized as an educational essential, should be introduced into our curricula, it is well to wait until some general synthesis of opinion has been effected before attempting a general summary of conclusions. In practise, we shall arrive at the type of science teaching that commends itself to those who are most closely in contact with present needs and conditions. But it may help to clear the air of controversy if two points of view are restated which are coming into gen-

eral recognition, the one as a result of educational thought before the war, the other in connection with the wide upheaval of opinion that the war has caused.

In December, 1912, we published a draft scheme for the teaching of science upon a synthetic method—the term "synthetic," in this case, implying that science was to be taught as a whole in the more elementary stages, with the rudiments of the separate, specialized sciences blended together and taught in connection with one another as parts of a single realization. The sciences were in danger of becoming the monopoly of specialists; not a mere financial monopoly. but a monopoly of faculty and intelligence. In a civilization increasingly governed by science, it seemed to us of importance that citizens should have a general comprehension of science. More than this: specialists themselves go wrong if they never fully realize the broad foundations of their specialties. A narrow specialist is a bad specialist. The more important specialism in science was destined to become, the more essential we felt it to be that a wide general conception of science should be taught; not only that people might have some conception of the scientific principles upon which they were increasingly governed, but also that the specialists of the future might have a broader foundation for their work through a better realization of the dependence of one branch of science upon the others.

The war has taught us by force what we might not, perhaps, have learned so rapidly by the peaceful exercise of our wits: that in national endeavor all branches of activity must be subordinated to a conception of the whole. The present demand for more science comes of a recognition that, for all our special excellences, our general ignorance of causes had come near to destroying us. And with this recognition there comes a conception of science that goes beyond a synthesis of "the sciences." The scientific outlook, the scientific method, call for a place not only in science teaching, but in all teaching. This is not because we admire German scientific organization. As a matter of pure science, we detest German scientific organization because it is fundamentally unscientific, just as it is fundamentally inhuman. It favors prejudices, not truths. We want to put a right scientific organization in its place; we have seen the results of having no scientific organization at all, though we have battled against these evil results with extraordinarily rapid success.

The war is teaching us a new science of our own and a new humanism of our own. Both are in embryo, as far as education is concerned; much thought and discussion are still needed for the further evolution of a complete system. But one thing becomes increasingly clear. There is no war between our new science and our new humanism. The dying quarrel lies between prejudices rather than between principles. We need a science teaching that is complete and unified; but by now we are coming to realize that we also need a humanistic science, and a humanism that is scientific. Such a solution, if we take the pains to work it out, will be thoroughly in accord with the English genius.—*London Times Educational Supplement.*

## SCIENTIFIC BOOKS

*Bridge Engineering.* By J. A. L. Waddell. John Wiley and Sons, New York, 1916. 2 Vols. 2177 pp.

Like most branches of science or of engineering, the field of structural engineering is abundantly supplied with text-books and treatises. However, as in a vocation there is always room at the top, so in the literature of a subject there is always room for a new work if it presents the subject from a fresh point of view, or if it contributes something new, or puts in a new light something which may be a matter of even common knowledge.

In engineering there is always opportunity for a contribution which will be of value if it embodies results of experience, even upon subjects of which the fundamental principles are well understood, for engineering deals with the applications of science, and, in those applications, conditions are so available that, as is well known, good judgment, common sense and

the ability to meet emergencies are more important requisites for success than deep or accurate scientific knowledge.

The author of the work under review is not only possessed of deep and accurate scientific knowledge, but has had an exceptionally wide and valuable experience as an engineer. The present work is not an ordinary text-book; indeed most of the subjects discussed in ordinary text-books are entirely omitted here. This work begins, broadly speaking, where the usual text-book leaves off, and concerns itself with an exhaustive discussion ranging from large questions down to details of design, and throughout it all the author draws upon his experience, and, in an easy conversational way which makes the book very readable, places here on record his opinions, his deductions, and his experiences regarding most of the important matters involved in the design of bridge structures.

The work is a large one, comprising two bulky volumes, with a total of over two thousand pages. Indeed, if any criticism is to be made of the work, it is that it is too bulky and includes some information which might well have been omitted, such for instance, as a glossary of terms covering 220 pages which might have been relegated to a technical dictionary rather than included in a treatise on bridge engineering. However, the book, as stated, is not a text-book, and will not be carried about by college students in their grips; it is a reference book for the office and for the consulting engineer, and for such it will be found of great value. The bridge engineer who desires to inform himself with reference to any type of structure, or to investigate any particular problem, will be apt to find in this work some clue which will guide him, if indeed he does not find the direct answer to his inquiry.

The book is rather uneven, it is true, in its treatment, devoting for instance, forty-eight pages to the subject of cantilever bridges, thirty pages to arches of all the various kinds, sixteen pages to suspension bridges, and seven pages to wooden bridges and trestles. However, the work does not pretend to be a complete treatise; it is supplementary to the usual text-books and the author has not thought it necessary or desirable, merely for the sake of completeness, to cover ground which is quite adequately treated in other works. This work is supplementary to such treatises and aims to give the profession the results of the experience and study of its author, and the opinions which he has been led to hold on the various matters of bridge design and construction. It will be found a very valuable work for the consulting engineer and the bridge specialist, while the engineering student will find an opportunity therein to pursue lines of inquiry upon which he may be engaged, and to learn the opinions of an eminent bridge engineer.

A characteristic of the work is the inclusion therein of a number of chapters relating to matters not generally touched upon in such works, such, for instance, as "Esthetics in Design," "Office Practise," "Bridge Failures and Their Lessons," "Responsibility of the Bridge Engineer," "Ethics of Bridge Engineering." A very interesting chapter is that on "Expedients in Design and Construction" in which instances are give of the exercise of the important quality of "gumption" which every successful engineer must possess in greater or less degree. The book will be found of value, not only for the technical information which it contains, but because it emphasizes the necessity for qualities, other than mere mathematical ability or an understanding of small technical details, for the successful structural engineer. It is a book which will tend to broaden the view and so increase the usefulness of the young engineer.

GEORGE F. SWAIN
HARVARD UNIVERSITY AND THE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

## SPECIAL ARTICLES

### ON THE ELECTRIC ORGANS OF GYMNOTUS CARAPUS

IT was suggested to the writer by Professor U. Dahlgren, of Princeton University, that *Gymnotus carapus* might furnish material for the study of electric organs. Miss A. Lowrey[1]

[1] *Jour. Morph.*, Vol. 24, p. 693.

in her examination of several Gymnotid fishes was unable to find electric tissues. She found that

> in or between the first and second muscular units of the ventral portion of the great lateral muscles, there was a slight degeneration of parts of the muscles. The larger units had been reduced to two minute oval muscles embedded in either strands of cartilage, or strands of cartilage and fat, and occupied parts of two triangular spaces, one on each side of the median septum just above the (muscle) unit which controls the anal fin. No plates, special nerve fibers, or nerve endings were seen.

In my examination of the specimen which had been collected by Professor Dahlgren some years ago, I noticed that when the fish was scaled a portion of the body appeared almost translucent. The location of this part corresponds exactly to the location described by Miss Lowrey where "slight degeneration of parts of the muscles" had taken place. Sections were made of this portion of the body, and a study of these has shown beyond all doubt that the portion of the body in question is composed of electric tissue. Not only were the characteristic electroplaxes found, but also the special electric nerve fibers and blood-vessels supplying them.

The fish used for this study measured approximately 31 cm. in length. The body is more or less filiform, tapering to an extremely finely pointed tail. The head is flattened dorsally and the upper lip projects slightly over the lower lip. The gill opening is rather small with a dusky spot just above it. The vent opens just behind the throat. The dorsal fin is entirely lacking, while the ventral fin extends from the tip of the finely pointed tail to a position just posterior to the vent opening. The fin is controlled by a muscle unit lying just dorsal to it. The electric organs extend from the tip of the tail forward, following along the entire length of the ventral fin and lying dorsal to the muscle unit controlling the fin. There are two such organs, one on each side of the body, each tapering more or less at the cephalad and caudad ends, thus giving the organs the form of much-elongated spindles. In cross-section these electric areas appear triangular in shape and are separated by the median septum.

The electric spindles are divided into five longitudinal tiers by horizontal sheets of connective tissue running the entire length of the organ. In these tiers the electroplaxes are arranged perpendicular to the septa in compartments bounded by the electrolemma and embedded in the "electric jelly." These compartments, with the electroplaxes lying in about the middle, are relatively large, with the result that the electroplaxes are rather widely separated. Since the strength of the electric current produced is proportional to the number of electroplaxes, it is safe to assume that the electric current produced by *G. carapus* must be extremely weak, if it is at all perceptible.

The electroplaxes are plainly seen in any section taken through the electric organ. They are more or less square or oblong in shape, with irregular projections (papillæ) on the cephalad and caudad sides. These papillæ are usually longer on the caudad sides. Numerous oval nuclei are arranged peripherally and no cell walls are present. The core of the electroplax is homogeneous in appearance. The nerves and blood-vessels always approach the caudad side of the plates, a condition which is similar to that found in the electric eel and other Gymnotids.

It is thus evident that the tissue which Miss Lowrey has described as degenerated muscle units is really an electric organ. Her mention of "strands of cartilage" being intermingled with the degenerated muscle leads me to believe that she has seen the electroplaxes and interpreted them as being cartilage. They are usually of a homogeneous, hyaline appearance and with their numerous nuclei might present a cartilaginous appearance. Yet their form is that so characteristic of electric plates that one can not overlook them.

Another of the Gymnotids which Miss Lowrey has examined and reported to possess no electric organs is *Eigenmannia virescens*. In the posthumous work of Sachs (1881) on *Gymnotus electricus*, some of his field notes are published which describe and figure por-

tions of the body which he considered to be the electric organs of *Eigenmannia* (*Sternopygus*). It is interesting to note that his description of the macroscopic appearance of the electric organs exactly fits that of *Gymnotus carapus* presented here.

From an evolutionary standpoint, the weak or pseudo-electric fishes form a subject of interesting speculation. The Gymnotids (except *Electrophorus electricus,* the electric eel) and certain of the Raiidæ possess these weak electric organs. Darwin, in his "Origin of Species"[2] has admitted that the electric organs of fishes present difficulties to his theory of natural selection. Are the weak electric organs rudimentary, or are they new organs in the process of progressive development? If they are rudimentary why have they been discarded; if they are new organs just beginning to appear, of what selection value can they be if they produce no perceptible electric current? Only a study of the development of these organs can throw light on these questions. In certain of the Raiidæ which have been investigated it seems quite evident that the electric organs have been recently acquired and are not, therefore, the rudiments of previously existing well-developed ones.

ELMER L. SHAFFER

PRINCETON UNIVERSITY,
December 14, 1916

## THE AMERICAN SOCIETY FOR PHARMACOLOGY AND EXPERIMENTAL THERAPEUTICS

THE eighth annual session of the Pharmacological Society took place on December 28, 29 and 30, 1916, at Cornell Medical School, New York City. The other members of the Federation of American Societies for Experimental Biology met at the same time and place.

The sessions were opened and concluded by a joint meeting of all four societies. The papers read at these meetings will be found in the report of the General Secretary of the Federation. In addition to these joint meetings, the Pharmacological and Physiological Societies held a joint session devoted entirely to demonstrations on Friday afternoon, December 29.

[2] P. 167, sixth edition.

*Officers for 1917.*—The following officers were elected for the present year:

*President:* Reid Hunt.

*Secretary:* L. G. Rowntree.

*Treasurer:* Wm. deB. MacNider.

*Additional Members of the Council:* John Auer, Carl Voegtlin.

*Membership Committee:* Torald Sollmann (term expires 1919).

*New Members:* The following candidates were elected to membership upon recommendation by the membership committee and the council: Franklin C. McLean, Union Medical College, Peking, China; Harold B. Meyers, University of Oregon; Maurice I. Smith, University of Michigan; Julius M. Rogoff, Western Reserve University; James A. Waddell, University of Virginia.

*Membership in the A. A. A. S.*—The attention of new members is called to the following resolution of the council of the American Association for the Advancement of Science:

*Resolved,* that the entrance fee to this association shall be remitted for members of regularly affiliated societies who are elected to the A. A. A. S. within one year of their election to membership in the affiliated society.

The extension of this privilege (it was formerly limited to the year 1916 only) to all new members of affiliated societies *for the year in which they join the affiliated society,* is greatly to be welcomed, and all new members of the Pharmacological Society should avail themselves of this opportunity.

*Amendment of the Constitution.*—The mandatory provision of Article V., Section 1, that the annual meeting of the society be held between December 25 and January 1 at a place determined by the council was altered to read: "The annual meeting of the society shall be held at a time and place determined by the council in consultation with the executive committee of the Federation of American Societies for Experimental Biology." The federal executive committee, it may be added, is formed by the presidents and secretaries of the constituent societies of the federation.

The object of this amendment was to permit a tentative change of the meeting time, if a majority of the federated societies should deem this advisable. There are a number of reasons why the scientific sessions should be held at some other time of the year than Christmas week: the season is usually inclement and imposes hardships and dangers on all members, especially the elderly, who are compelled to travel considerable distances in order to attend; the time available for the preparation of papers from the beginning of the

school year to December 1 when the title usually must be in the hands of the secretaries, is too short; in addition the December meetings interfere with, and for many practically abolish, the Christmas holidays as a family festival.

*Privileges of Discussion.*—As a number of inquiries were received during the last two years concerning the privilege of discussing papers before the Pharmacological Society by members of the Federation who do not belong to the Pharmacological Society, it was moved, seconded and unanimously carried that this privilege be accorded to all members of the Federation. At the same time, the executive committee-members of the society were instructed to propose before the executive committee of the Federation that all the constituent societies grant the same privilege, so that any member of one society is entitled to join the discussion of any paper delivered before any other society.

It should be noted that this motion refers only to the privilege of the floor; it obviously does not confer the right to read a paper before a society of which the author is not a member. Such a transfer can only be made after the consent of the secretary of that society has been obtained before which the paper is to be read.

*Meeting Place in 1917.*—The next meeting of the Pharmacological Society, together with the other members of the Federation, will be held at the University of Minnesota in Minneapolis.

*Dinners and Smokers.*—Two informal dinners and smokers were given, the first at the Hotel McAlpin on December 28, and the second at the Chemists Club on December 29. At the first dinner, with Dr. Simon Flexner as toastmaster, speeches were delivered by Drs. Mendel, Pearce, Carlson, Cannon and Jones.

*Scientific Program.*—Before giving a list of the papers read and discussed, it may be mentioned with satisfaction that all papers announced by their authors for delivery were read with but one exception, and in this instance the title was changed.

DECEMBER 28, 2.00–4.30 P.M.

"Pharmacological Studies with Cocain and Novocain," by G. B. Roth.

"The Fate of Iodin, Iodids and Iodates in the Body," by T. Sollmann.

"The Fate of Strychnin in the Animal Body," by R. A. Hatcher and Cary Eggleston.

"The Reduction of Toxicity of Strychnin by the Simultaneous Administration of Large Quantities of Fluid," by I. S. Kleiner and S. J. Meltzer.

"The Action of Strychnin in Cardiac Arythmias," by M. I. Smith (by invitation).

"Bio-Assay and Variability of Veratrum Preparations," by J. D. Pilcher.

"The Pharmacological Activity of Digitalis Grown in America," by J. H. Pratt and H. Morrison (by invitation).

"Digitalis in Cardiac Irritability," by C. C. Guthrie.

"The Toxicity of Digitalis for Normal and Vagotomized Cats," by D. I. Macht and H. Colson (by invitation).

"Responses of Fish Melanophores to Sympathetic and Para-Sympathetic Stimulants and Depressants," by H. G. Barbour and R. A. Spaeth (by invitation).

"The Action of Fluorescin and its Derivatives on the Circulation," by W. Salant and R. Bengis (by invitation).

"The Action of Succinate and its Derivatives on the Isolated Frog Heart," by W. Salant and A. E. Livingston (by invitation).

DECEMBER 29, 9.00–12.30 P.M.

"The Effect of Unilateral Excision of the Adrenal, Section of the Splanchnic Nerve and Section of the Renal Nerves on the Secretion of the Kidney," by E. K. Marshall, Jr., and A. C. Kolls (by invitation).

"The Effect of Nicotin on the Two Kidneys after Unilateral Section of the Splanchnic Nerves," by A. C. Kolls (by invitation) and D. K. Marshall, Jr.

"The Protective Action of Diet against Renal Irritants," by W. Salant and R. Bengis (by invitation).

"A Consideration of the Relative Toxicity of Uranium Nitrate for Animals of Different Ages," by W. deB. MacNider.

"A Study of the Conditions affecting the Rate of Excretion of Phenosulphonephtalein," by R. R. Snowden (by invitation), Clyde Brooks and T. S. Arbuthnot (by invitation).

"The Action of Distilled Water on the Isolated Uterus," by C. Voegtlin and G. C. Lake (by invitation).

"A Study of Ethylhydrocuprein (Optochin) in Lobar Pneumonia," by H. F. Moore (by invitation) and A. M. Chesney (by invitation).

"Further Observations on Albuminuria and Changes in Renal Function following Full Therapeutic Doses of Salicylate," by R. W. Scott (by invitation), T. W. Thoburn (by invitation), and P. J. Hanzlik.

"The Excretion of Salicylate in Various Clinical Conditions," by R. W. Scott (by invitation), T. W. Thoburn (by invitation) and P. J. Hanzlik.

"Salicylate Oedema," by R. W. Scott (by invitation), J. L. Reycraft (by invitation) and P. J. Hanzlik.

"The Favorable, Antagonistic Effect of Magnesium Sulphate against Poisonous Doses of Sodium Oxalate," by F. L. Gates and S. J. Meltzer.

"Further Observations on the Pathological Changes in the Tissues of the Rabbit, as a result of Reduced Oxidation," by G. H. Martin (by invitation), C. H. Bunting (by invitation) and A. S. Loevenhart.

DECEMBER 29, 2.00–5.00 P.M.

*Joint Demonstrations by the Pharmacological and Physiological Societies*

"A Signal Magnet which writes either upwards or downwards," by W. Hale.

"Some New Apparatus," by D. E. Jackson.

"An Improved Lever for Frog's Heart and Muscle Strips," by A. H. Ryan.

"The Inhibitory Effect of Stimulation of the Central End of the Vagus Nerve upon the Contractions of an Active Expiratory Muscle in the Chicken," by A. L. Meyer (by invitation).

"Demonstration of a Gas-Analysis Apparatus," by Yandell Henderson.

"The Motion Picture as an Aid in Teaching Physiology," by J. A. E. Eyster and W. J. Meek.

"Pathescope Films used to illustrate Physiological Demonstrations to Students," by Alexander Forbes.

"Motor Phenomena of the Stomach and Cap as observed Roentgenographically," by Gregory Cole (by invitation).

"Photographs representing the Growth of Chickens Fed with Definite Mixtures of Foodstuffs under Laboratory Conditions which have heretofore not led to Success," by Thomas B. Osborne and Lafayette B. Mendel.

"Microscopic Demonstration of Absence of Chromatolytic Change in the Central Nervous System of the Woodchuck (*Marmota Monax*)," by A. T. Rasmussen (by invitation) and J. A. Myers (by invitation).

"Glycogen in the Blood Vessels of the Liver," by G. Carl Huber and J. J. R. Macleod.

"A Method of Recording Fundamental Heart Sounds Directly from the Heart," by Carl J. Wiggers and A. Dean, Jr. (by invitation).

"Exhibit of Photographically Recording Apparatus for studying the Dynamics of the Circulation," by Carl J. Wiggers.

DECEMBER 30, 9.30–12.00 M.

"Studies on Tolerance and Cumulation: Experiments with Tartrates, Citrates and Oxalates," by W. Salant and A. M. Swanson (by invitation).

"The Effect of Morphin and Opium on Psychological Reaction Time," by D. I. Macht and S. Isaacs (by invitation).

"On the Drug-fastness of Spirochætæ against Certain Arsenical, Mercurial and Iodid Compounds in Vitro," by H. Noguchi and S. Akatsu (by invitation).

"On the Relative Toxicity of Salvarsan and Neosalvarsan," by L. Pearce and W. H. Brown.

"The Action of Ethylenediamin," by H. G. Barbour and A. M. Hjort (by invitation). (Read by title.)

"The Influence of Eserin upon the Partially Excised Sphincter Pupillæ," by D. R. Joseph.

"The Mutually Antagonistic Actions of Adrenin and Eserin upon the Sphincter Pupillæ," by D. R. Joseph.

"The Effects of Pituitrin and of Adrenin of the Pupil of Gangliectomized Rabbits," by T. S. Githens and S. J. Meltzer.

"The Prolonged Reaction of the Blood Vessels of the Rabbit's Ear to the Local Injection of Adrenin," by J. Auer and S. J. Meltzer.

"The Effect of Ergotoxin on the Temperature of Rabbits," by T. S. Githens.

"A Respiratory Factor in the Production of Adrenin Pulmonary Œdema in Rabbits," by F. L. Gates and J. Auer.

At the second executive session of the society on Friday noon, December 29, a vote of thanks was unanimously tendered the authorities of Cornell Medical School for their hospitality and efficient arrangements and to the local committee for its efforts in behalf of the visiting members and guests.

JOHN AUER,
*Secretary*

ROCKEFELLER INSTITUTE

## SOCIETIES AND ACADEMIES

### THE TENNESSEE ACADEMY OF SCIENCE

THE seventh meeting (fifth annual meeting) of the Tennessee Academy of Science was held on December 1, 1916, at George Peabody College for Teachers, Nashville, Tenn. President Samuel M. Bain presided. The following papers were read and discussed:

"The Development of Transportation on the Great Lakes," by Professor A. E. Parkins, Peabody College, Nashville.

"An Apparatus for Moisture Determination,"

by Professor A. S. Eastman, University of the South, Sewanee.

"Chemists' Present Opportunities and Duties," by Dr. J. I. D. Hinds, Castle Heights School, Lebanon.

"Some Practical Applications of Bacteriological Research," by Dr. Herman Spitz, Nashville.

"The Raison d'être of the Tennessee Academy of Science," by Dr. Samuel M. Barton, University of the South, Sewanee.

"The Origin of Reelfoot Lake," by Dr. A. H. Purdue, State Geological Survey, Nashville.

"Following the Compass across Sahara," by Dr. D. W. Berky, University of the South, Sewanee.

"James M. Safford," by Dr. J. T. McGill, Vanderbilt University, Nashville.

"West Indian Hurricanes: Their Origin, Movement and Extent," by Roscoe Nunn, U. S. Weather Bureau, Nashville. (Discussed by R. S. Maddox, State Forester, Nashville.)

Annual address of the president: "The Interrelation of Plant and Animal Pathology," by Professor Samuel M. Bain, University of Tennessee, Knoxville.

The election of officers for the ensuing year resulted as follows:

*President,* Samuel M. Barton, University of the South, Sewanee, Tenn.

*Vice-president,* Archibald Belcher, Middle Tennessee State Normal School, Murfreesboro, Tenn.

*Editor,* A. H. Purdue, State Geologist, Nashville, Tenn.

*Secretary-Treasurer,* Roscoe Nunn, U. S. Weather Bureau, Nashville, Tenn.

The president appointed as members of the executive committee, Dr. Brown Ayres, University of Tennessee, Knoxville, Tenn., and Dr. John T. McGill, Vanderbilt University, Nashville, Tenn.

Roscoe Nunn,
*Secretary*

Nashville, Tenn.

## THE BIOLOGICAL SOCIETY OF WASHINGTON

The 560th meeting of the society was held in the Assembly Hall of the Cosmos Club, Saturday, November 18, 1916, called to order by President Hay at 8 P.M. with 86 persons in attendance.

On recommendation of the council, Irwin Hoffmann was elected to active membership.

Under the heading, brief notes, exhibition of specimens, Dr. O. P. Hay exhibited one of the cervical vertebræ of a deer from a deposit in Florida. He called attention to the fact that the remains of Florida deer have usually been referred to the existing species, *Odocoileus osceola.* A comparison of this vertebra with the corresponding one from recent deer, other than the Florida deer, showed that possibly the extinct Florida deer was a different species from the existing deer. Dr. Hay said that there were no examples of cervical vertebræ of Florida deer for making comparisons, and until such examples were seen the identification of the extinct deer must remain doubtful.

Under the same heading Dr. Paul Bartsch called attention to a hybrid duck which he had lately seen exposed for sale in the markets. It was a cross between the black mallard and the domestic duck.

The regular program consisted of two papers:

H. Pittier: "Forests of Panama," illustrated by lantern slides.

Professor Pittier gave first a condensed review of the results to the present date of the botanical part of the biological survey of Panama, undertaken under the auspices of the Smithsonian Institution. Then he showed how the distribution of the main ecological types of vegetation is dependent upon the régime of the winds and of the rainfall. Mixed dicotylous forests cover at least six tenths of the area of the Isthmus, the rest being occupied by savannas and park-like formations. Rain-forests with evergreen foliage extend over the entire northern watershed and part of Darien on the south side. Other forests of the southern slope belong to the type called monsoon-forest and are characterized by the presence of many species with deciduous foliage. The xerophytic character of the vegetation is more marked in the broken forests of the savanna-belt, without, however, assuming an extreme degree. The change in the composition of the vegetation with the increase in altitude has been dwelt upon by several travelers and botanical explorers of the Isthmus; it is very gradual but nevertheless very radical. Several genera of trees observed at high altitudes are gregarious; there are, for instance, oak-forests, subtropical or even temperate in their general appearance. Lantern slides illustrating types of forest, or of individual trees and flowers, were shown at the conclusion of the lecture.

J. H. Paine: "Scientific Photography in the Study of Insects," illustrated by lantern slides.

During the last half of the meeting Dr. H. H. T. Jackson was acting secretary.

M. W. Lyon, Jr.,
*Recording Secretary*